Suiting up for the new millennium

WHAT TYPES OF SPACESUITS will be required to support long-duration human space flights planned for the next millennium? NASA will need advanced spacesuits and life support systems that will be able to withstand extended space walks to operate the International Space Station or travel back to the moon or on to Mars.

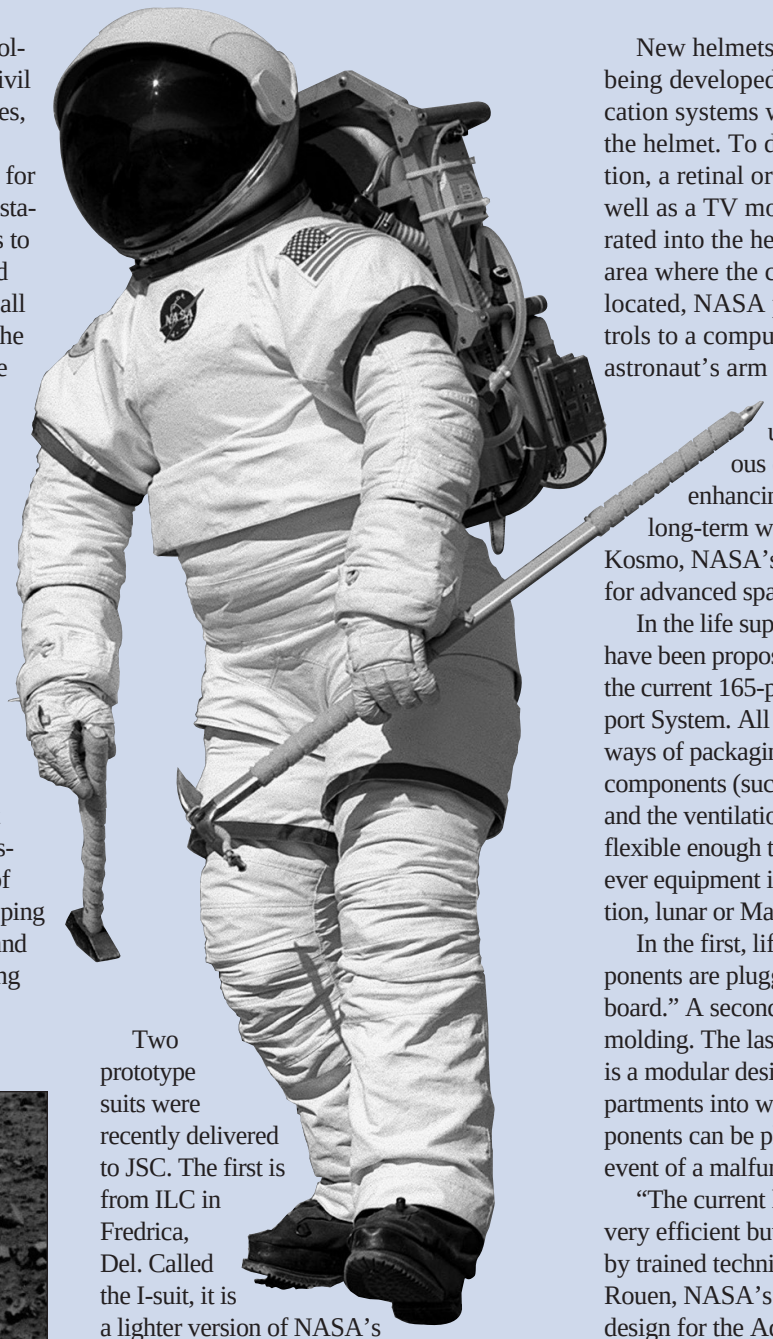
Beyond developing new suits and life support systems, new gloves, helmets and computers are being developed to meet increasing performance demands. The space-walking astronaut travels in a personal spaceship, complete with propulsion, communications and thermal control systems. New technologies are creating new products to fill needs in each of these areas.

"In the space-walking world, we think of the astronaut as embodying the whole spacecraft in miniature," says Mike Lawson, NASA project manager of the Advanced Technology Spacesuit Project. "All of the systems that are in a spacecraft are in this one-person spacecraft. That's what makes this particular area very unique. While most people work on one element or system, we work on almost all of them."

Members of JSC's Advanced Technology Spacesuit Project team, including civil servants and Lockheed Martin employees, are currently developing and evaluating new spacesuits and life support systems for three different missions: post-assembly station flights, lunar missions and missions to Mars. The next-generation spacesuit and life support system could be similar for all three missions except for hardware for the Mars mission, which will require unique carbon dioxide removal and thermal insulation systems.

"We've changed our philosophy from looking at what spacesuit provides the best mobility to considering the weight of the spacesuit as well," adds Lawson. "The objective now is to make spacesuits more mobile and lighter."

Those suits may be used for ISS operations. Beyond that, NASA has no official plans for a human space flight back to the moon or on to Mars, but the Advanced Technology Spacesuit Project team has to be prepared for whatever missions may come along. As a major part of this effort, outside contractors are developing the new spacesuits, while civil servants and Lockheed Martin employees are designing the life support systems on site.



Two prototype suits were recently delivered to JSC. The first is from ILC in Fredrica, Del. Called the I-suit, it is a lighter version of NASA's current 125-pound spacesuit. It has a soft upper and lower torso with minimum use of bearing "joints." The suit weighs 65 pounds (without life support).

The second prototype, from David Clark Co. in Worcester, Mass., was designed to have fewer metal bearings to reduce weight. The suit is modeled after the NASA escape suit worn for emergency escapes during shuttle liftoffs and landings, but with several additions and modifications to the joints. Fabric toroidal joints in the knees and hips are flexible without being heavy. The suit weighs in at a slight 26 pounds.

New helmets and computers are also being developed. Advanced communication systems will be integrated into the helmet. To deliver visual information, a retinal or heads-up display as well as a TV monitor could be incorporated into the helmet. To clear the chest area where the controls for the suit are located, NASA plans to move all controls to a computer mounted on the astronaut's arm or wrist.

"We are also continuing to investigate various developments towards enhancing glove mobility and long-term wear comfort," says Joe Kosmo, NASA's senior project engineer for advanced spacesuit development.

In the life support arena, three designs have been proposed as replacements for the current 165-pound Portable Life Support System. All three are suggested ways of packaging life support system components (such as the oxygen module and the ventilation loop). Each design is flexible enough to accommodate whatever equipment is needed to support station, lunar or Mars missions.

In the first, life support system components are plugged into a "motherboard." A second fits parts into a foam molding. The last, called the LEGO ™, is a modular design that features compartments into which life-support components can be placed and replaced in the event of a malfunction.

"The current life support system is very efficient but has to be maintained by trained technicians," says Mike Rouen, NASA's head of mechanical design for the Advanced Technology Spacesuit Project. "For this reason, it is not the best for long-duration missions where astronauts will have to maintain the system. We plan to develop a life support system that the astronauts can easily maintain in space."

In the next few years, NASA will choose the best ideas from each spacesuit and each life support system prototype. The end objective is to develop a new suit and a new life support system to be tested in a vacuum chamber in 2003. ■

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1. LEGO Team members are, from left, front: Heather Paul, NASA; Mary O'Connell, team lead, Lockheed; Luis Trevino, NASA; back: Kevin Groneman, ILC; Kase Urban, ILC; Robert Trevino, NASA; Eric Kanon, Lockheed; Mark Swan, ILC; Sharon Lafuse, NASA.
2. Foam Team members are, from left, front: Wendel Smith, ILC; Kevin Groneman, ILC; back: Heather Paul, NASA; Kase Urban, ILC; Richard Stinson, Lockheed; Scott Andrea, Lockheed; Eric Kanon, Lockheed; Mike Rouen, NASA; Mark Swan, ILC.
3. Members of Motherboard Team are, from left, front: Howard Slade, team lead, Lockheed; Heather Paul, NASA; back: Siraj Jalali, Lockheed; Kase Urban, ILC; Dwayne Kautz, OSS; Cyle Sprick, OSS; Eric Kanon, Lockheed; George Kessler, OSS; Jeff Templeman, OSS.